U. S. DEPARTMENT OF AGRICULTURE

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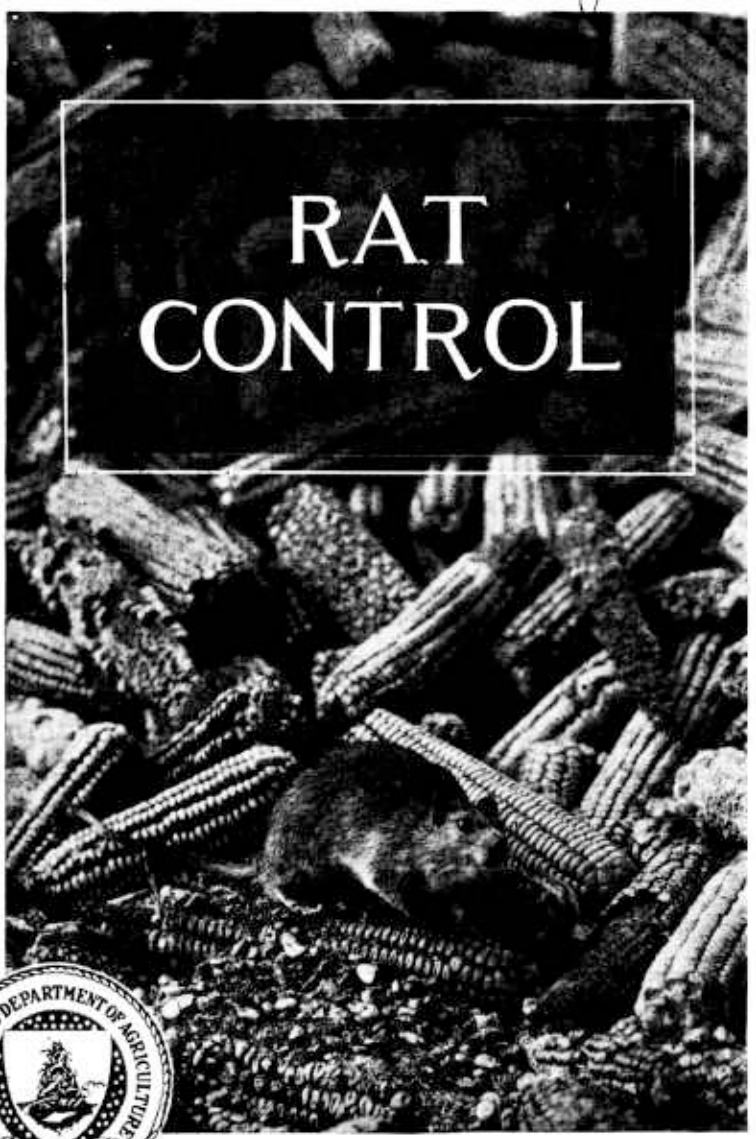
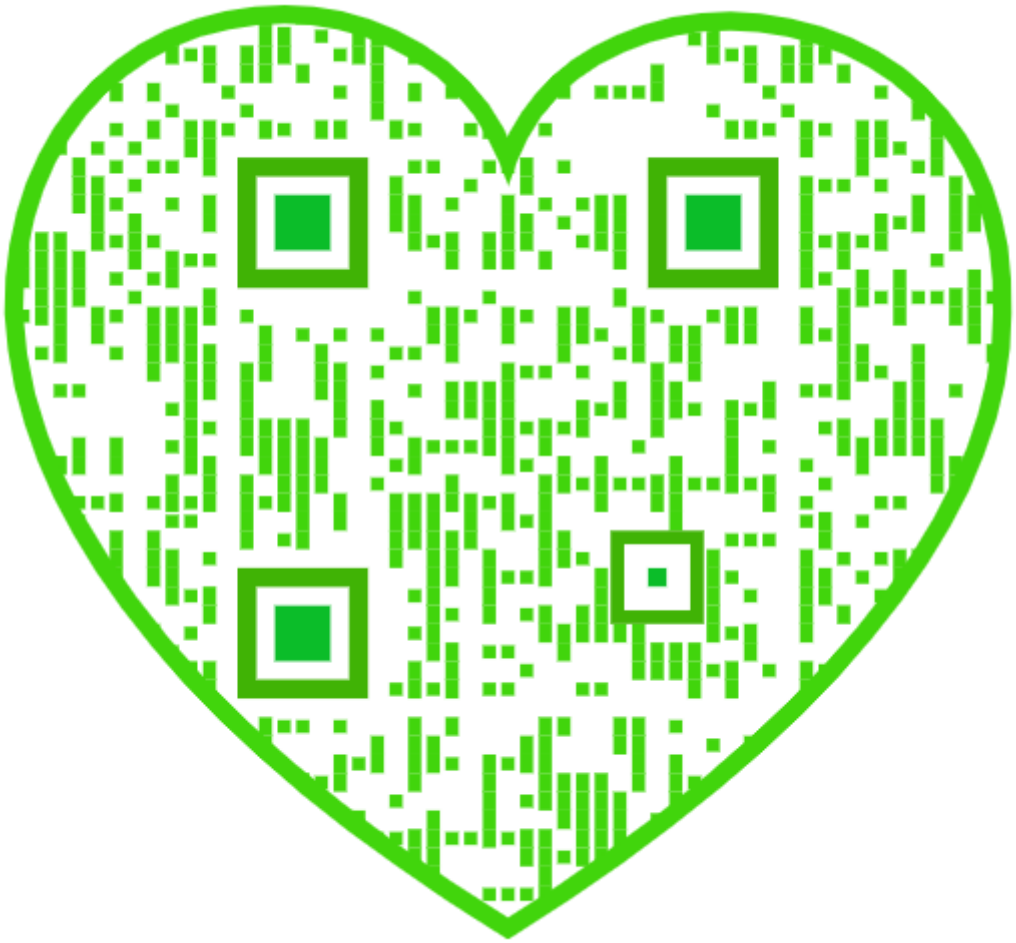
RAT CONTROL





RATS are probably decreasing in numbers in the United States, although their decrease is only beginning to be apparent. The chief factors responsible for any diminution are present-day sanitary requirements and modern building, which make it increasingly difficult for rats to find food and shelter; a national urge against all unnecessary waste; and a better understanding generally of the relation of rats to human economy. Furthermore, as facts relating to the spread of communicable diseases have become better known, more general interest in rat control has been stimulated, more effective means of destroying rats have been developed, and information regarding these methods has been widely distributed. In addition, individuals and organizations are showing a greater willingness to cooperate with scientific and governmental agencies in waging a general and sustained warfare against these destructive rodents.

In spite of all that has been done to combat the rat, however, this pest is still mankind's greatest enemy in the animal world. This bulletin describes modern methods of excluding and destroying the pest. It supersedes Farmers' Bulletin No. 1302, How to Get Rid of Rats.

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RAT CONTROL

By JAMES SILVER, *Associate Biologist, Division of Predatory-Animal and Rodent Control, Bureau of Biological Survey*

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PERMANENT EXCLUSION OF RATS

THE PERMANENT EXCLUSION of rats involves primarily the proper construction, repair, and upkeep of buildings and keeping the premises in sanitary condition. Rats require both food and shelter for their well-being, and they can not persist where either of these elements is lacking. Rat infestation of premises can usually be traced to some condition favorable to the animals, and the removal of this condition discourages their presence and generally means permanent reduction of rat damage.

RAT-PROOFING

Most modern buildings and many older ones are so constructed as to be rat-proof or could be made rat-proof at relatively small cost. Owners of large warehouses, food depots, and other buildings in which produce and other supplies are subject to damage by rats have found that the cost of rat-proofing their buildings, even if the expense is considerable, is slight compared with the resulting protection from loss and that in the long run rat-proofing is the cheapest form of "rat insurance." (Fig. 1.) Wherever it can be accomplished at a reasonable expenditure rat-proofing is recommended as the best and most permanent means of rat riddance.

The first step in rat-proofing a building with brick, stone, or concrete foundation is to search thoroughly for all places in the structure where rats might enter, especially for small openings around pipes and for small cracks due to careless workmanship, sometimes in places where the exterior of the wall is hidden by porches or adjoining structures. Such openings should be closed with metal sheeting or with concrete. Basement windows and other large openings should be covered with strong and durable screening, such as stand-

ard 8-mesh galvanized hardware cloth, which will keep out flies as well as rats and mice. Ventilators and sewer openings should be provided with gratings, and doors that are likely to be left open at night should be equipped with self-closing devices.

Buildings without rat-proof foundation walls should be elevated 18 inches or more and kept open on all sides and free from all accumulations underneath. Corncribs, granaries, and other food-storage buildings of this type should be equipped in addition with metal rat guards at the tops of supporting columns or entirely inclosed with wire mesh. Some buildings, particularly barns and other open-type farm buildings, can not be rat-proofed economically, but in most cases rats can be kept under control by eliminating rat harbors as

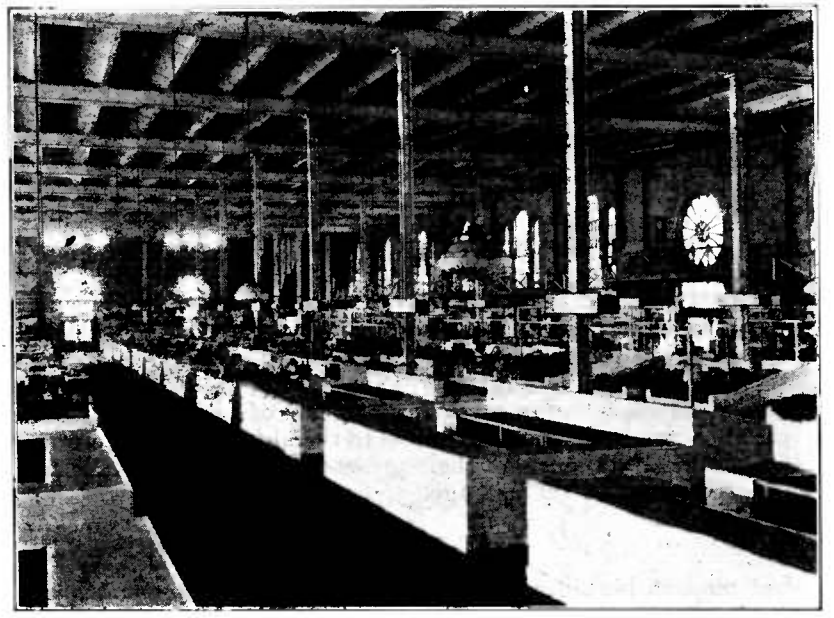

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FIG. 1.—In a rat-proof public market there is no destruction or contamination of food by rats, and thus the produce on display and in storage is protected and the public health safeguarded

far as possible and by persistently destroying the animals themselves. Further information relating to rat-proof construction and repair will be furnished on request by the Biological Survey, United States Department of Agriculture, Washington, D. C.

REMOVAL OF SHELTER

To remove places where, without fear of molestation, rats make their homes and raise their families is one of the most important problems in rat control. The surest way to permanent rat riddance is the removal of favorable rat harbors, for a rat will not remain where safe and comfortable shelter is not available.

The most common rat harbors are dead spaces within double walls and beneath floors. Considerable effort is usually required to abolish

these shelters, but it is often essential to permanent rat control. Double walls may be shut off from rats by stopping the openings left between the studs and floor joists just above the sill. In new structures these spaces should be filled to a height of 4 inches above the floor with cheap or broken bricks, a mixture of cinders and cement, or some other similar noncombustible material. (Fig. 2.) In old buildings walls may be stopped by fitting sheet metal between the joists and nailing it to the sill. Sealing hollow walls by these means is commonly called fire-stopping. It is now required by the building regulations of many cities and is of great value not only

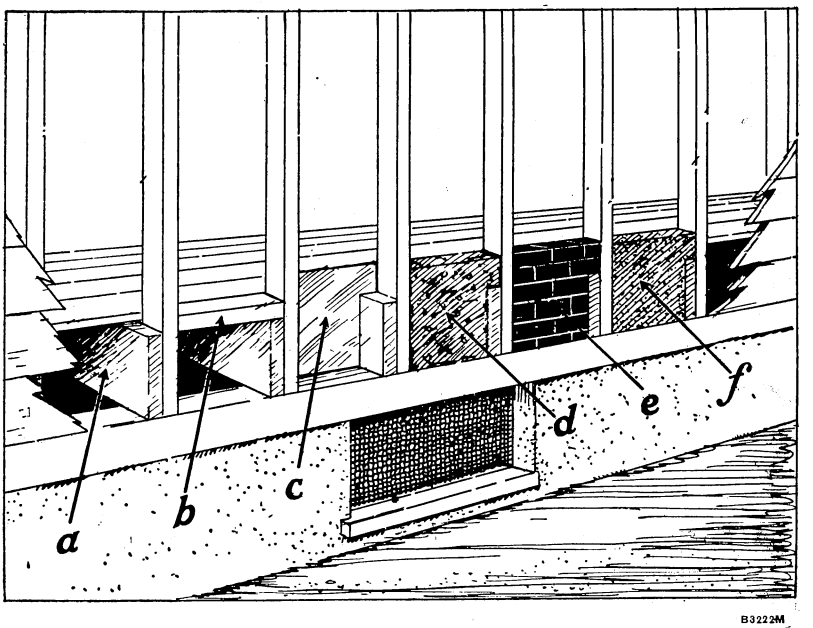

FIG. 2.—Methods of excluding rats from double walls: *a* shows a common type of building construction with open space between floor joists, which gives the rat free access to double walls; *b*, wooden 2-by-4 stops are sometimes employed, but as fire control is an important function of the stops, noncombustible material should be used (they may be used, however, in upper floors); *c*, in old buildings galvanized sheet metal may be cut to fit and be nailed into place between studs, joists, floor, and sill; in buildings under construction such noncombustible stops as cement and cinders (*d*), cheap or broken bricks (*e*), or concrete (*f*) are recommended

in retarding the spread of fire but also in improving insulation against heat and cold.

Wooden floors in buildings without basements, particularly on farms, provide a free shelter for rats. Where possible these floors should be replaced by concrete, with retaining walls extending 2 feet underground to prevent the rats from burrowing under the floor from the outside.

Other common rat shelters are those provided by stored produce and supplies, lumber piles, and accumulations of trash and refuse. (Fig. 3.) Waste should be disposed of promptly and stored materials elevated on platforms at least 18 inches off the ground or floor. Thorough cleanliness and orderliness discourage the presence of

rats and force them to seek other quarters. The entire removal of rat harbors is not always possible, but when this condition is approached the rat-riddance problem becomes simpler.

CUTTING OFF THE RATS' FOOD SUPPLY

Food is an important factor in all rat infestation. Food shortage limits the number of rats that premises will maintain and reduces the breeding of rats. Hunger also renders poisoning and trapping more effective. The important means of abolishing the rats' food supply are to store foodstuffs in rat-proof buildings, rooms, or containers and to dispose of waste and garbage in tightly covered receptacles. (Fig. 4.)

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FIG. 3.—Untidy premises in a thickly settled district invite community rat infestation. In such places trash should be disposed of and useful materials elevated on platforms

DESTRUCTION OF RATS

Although measures for the permanent riddance of rats should be taken wherever practicable, they usually must be combined with rat destruction, and in many places continual rat killing is the only practical method of control. There are numerous materials and contrivances designed for rat destruction, but in the experience of the Biological Survey relatively few of them have proved to be of outstanding usefulness. Employment of methods of destruction adapted to certain local conditions will simplify rat control.

POISONING

The most efficient means of destroying rats known to the department, and the one most generally recommended, is poisoning. The chief objections to the use of poison are its danger to human beings and domestic animals and the possibility that rats taking it will die

in inaccessible places, where their decomposing bodies may cause obnoxious odors. The first objection can be met by using as mild a poison as possible and by exercising proper care in exposing it. The second objection may be practically overcome by using a slow-acting poison.

Success in poisoning depends largely upon the baits used and the methods of mixing and distributing them. The all-important requirement is to set out the kinds of baits that the rats will eat. Experience has taught that the kind of poison used is generally of less importance than the kinds of bait used. Usually it is almost as difficult to get rats to eat unpoisoned foods as those that are properly prepared and poisoned. For this reason, regardless of the kind of poison used, it is important that care be exercised in selecting, mixing, and distributing baits.

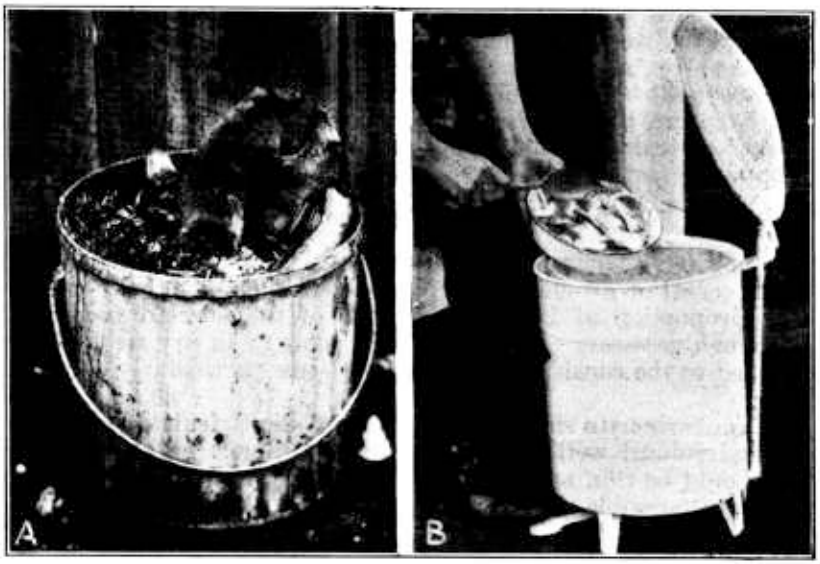

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FIG. 4.—The uncovered garbage can, A, is one of the most common sources of the rats' food supply. An automatic cover, B, is convenient

BARIUM CARBONATE

Barium carbonate (precipitated) is a heavy, white, mineral salt, mildly poisonous, tasteless, odorless, slow in action, and inexpensive, all of which characteristics contribute to its value as a rat poison. This compound has been proved also highly effective and dependable for killing rats when used in the proper way, and is therefore recommended above other poisons for this purpose wherever it can be used with safety. The only serious objection to barium carbonate is that baits containing it can not be distributed freely without endangering other animals. Although comparatively mild and far less dangerous than most of the poisons commonly used in commercial rat baits, it is nevertheless fatal to chickens, dogs, cats, and larger animals if eaten in sufficient quantity.

Barium carbonate can be used with safety, however, even in poultry runs if sufficient care is taken to expose it in such inaccessible places as behind or under boxes or behind boards leaned lengthwise against a wall to form a natural runway. In such cases the bait should be either in the form of meal or so wet that the rat can not drag it from cover.

The following directions for using barium carbonate have been carefully worked out and found to produce the best results:

KINDS OF BAIT

A variety of baits used separately gives the rat a choice of foods and increases the chances of the bait being taken. One kind of each of the following classes of food mixed separately with barium carbonate is recommended:

Cereals, such as bread, corn meal, and rolled oats.

Meats, such as Hamburg steak, sausage, sardines, or eggs.

Fruits and vegetables, such as apples, melons, and tomatoes.

Baits should be fresh and of good quality. Fresh kitchen scraps or garbage can be worked into the ration to advantage, but in such case it is desirable to run meat scraps and other hard food through a chopper to facilitate mixing with the poison.

HOW TO PREPARE BAITS

The powdered barium carbonate should be thoroughly worked into the soft cereal or ground-meat baits with the hands or with a spoon, in the proportion of 1 part to 6 parts of the selected food. Add water when necessary to make the baits moist. In dry weather baits moistened to the consistency of soft mush are particularly acceptable to rats.

Barium carbonate should be sifted over sliced fruit and vegetable baits and rubbed well into them with the fingers or a knife. The slices should be thin and should be moistened, if necessary, to attain as nearly as possible the 1 to 6 ratio.

HOW TO DISTRIBUTE BAITS

A teaspoonful of the prepared mixture is a sufficient quantity for the average rat bait. Put the baits in places frequented by rats, preferably where they have been observed to feed.

A convenient and successful method of exposing baits is to wrap teaspoonful quantities in small squares of newspaper or place them in small paper sacks and to close them by twisting the tops. When a variety of baits is used, wrap each kind separately and expose one of each kind in groups, or in sequence, to give the rats a choice. In public places, where there is a possibility of their being disturbed, baits should be wrapped and the packages labeled POISON.

It is important that a sufficient number of baits be distributed at one time to provide an ample supply for every rat on the premises; otherwise the resulting mortality will arouse the suspicion of the rats that are unharmed and will render subsequent baiting less successful. It is much better to prepare an excess of bait than not enough.

Baits should be distributed in the evening, so they will be fresh when the rats are feeding. Uneaten baits should be picked up the

following morning and destroyed, as stale baits usually are unattractive to rats and as the acids resulting from souring baits render barium carbonate bitter and objectionable.

If the poisoning has been carefully carried out, a high mortality may be expected. It often happens that the destruction of a large proportion of rats on premises results in frightening away the remaining few, so that moderately successful poisoning sometimes results in a complete clean-up. Should the poisoning operations not be wholly successful, it is well to wait two weeks or more before repeating with other baits.

PREBAITING

In stubborn cases, or when one is willing to go to additional trouble to increase the chances of success, prebaiting is recommended. This consists of exposing fresh, unpoisoned baits, prepared precisely as the poisoned baits will be later on except for omitting the poison. If these are taken freely the first night, poisoned baits should be substituted after an interval of one or two nights. Otherwise clean baits should be exposed at two or three day intervals (picked up in each case the following morning), until any suspicion the rats may have has been overcome and they take the baits without hesitation. When this occurs, they will doubtless take the poisoned bait the next night, and then the result should be a complete clean-up of the infestation.

Caution.—Barium carbonate is a relatively mild poison, but the danger from accidents must be emphasized. *Keep it out of the reach of children and irresponsible persons and from domestic animals and fowls.*

Antidote.—Give an emetic consisting of either mustard or salt dissolved in warm water, or induce vomiting by inserting the finger in the back of the throat. Follow vomiting with a liberal dose of Epsom or Glauber salts.

RED SQUILL

Squill is a perennial bulb that grows wild along the coast of the Mediterranean Sea. The bulbs are pear shaped (fig. 5), usually from 3 to 6 inches in diameter, and weigh up to 5 pounds. There are two commercial varieties, the white, used in medicine as a heart tonic, emetic, diuretic, and nauseant expectorant, and the red, which in addition has toxic properties of use as a rat poison. Squill contains calcium-oxalate crystals, which, on coming in contact with the skin, cause a sensation similar to that of a nettle sting.

Red squill as a rat poison has the distinct advantage of being relatively harmless to human beings and domestic animals. This is due in part to its acrid taste, which is highly objectionable to most animals, and also to the fact that it usually acts as an emetic when taken in dangerous quantities. Rats, however, usually take it readily and do not vomit, so that red squill approaches the unique position of being a poison specific to rats. Reports occasionally reach the department that chickens, cats, or dogs died after eating red-squill baits, but investigations thus far have not found squill to be the cause. Active red-squill preparations are therefore of particular value where the use of more toxic products would be inadvisable.

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The chief objection to squill is that it has no uniform toxic standard, so that commercial red-squill rat poisons are apt to vary considerably in potency. It is therefore important that individuals, as well as dealers, purchase their supplies from manufacturers who will guarantee the toxicity of their products.

Red squill is marketed in both liquid and powdered form, and either one is effective. The powder, as a rule, however, is more toxic to rats, less expensive, and keeps better; it can also be mixed readily with a wide variety of baits.

DIRECTIONS FOR PREPARING RED-SQUILL BAITS

Because of the variability of commercial red squill, it is necessary in preparing rat baits to vary the proportion of red squill to the foods used. Directions for use accompanying red-squill products

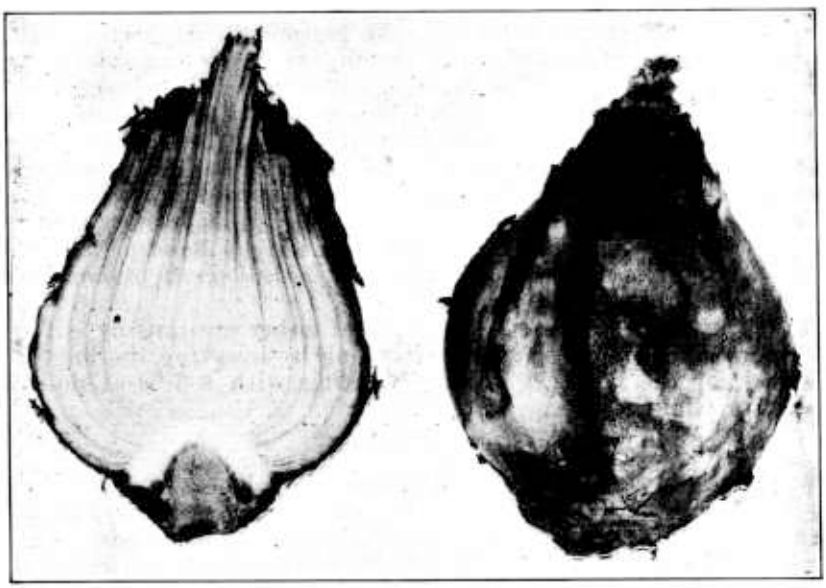

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FIG. 5.—Red-squill bulb (*Urginea maritima*)

purchased should serve as a guide in this respect. The proportions here given apply to the more toxic red-squill powders now on the American market. A variety of three or more kinds of baits greatly increases the chances for a thorough clean-up of the rats on any premises, and separate baits from three of the following classes should be carefully prepared:

Fish.—Fresh fish ground in a meat chopper is one of the most attractive baits for rats. If fresh fish is not available, a cheap grade of canned salmon, canned mackerel, or sardines in oil may be used. Mix 1 ounce of powdered red squill with a little water to form a thin paste free of lumps, add to 1 pound of fish, and mix thoroughly.

Meat.—Mix 1 ounce of powdered red squill with a little water to form a thin paste free of lumps, add to 1 pound of fresh ground meat, and mix thoroughly. Hamburg steak is most commonly used.

Cereals.—Mix together, dry, 1 ounce of powdered red squill to 1 pound of cereal meal, such as oatmeal, graham flour, corn meal, or bran. Add 1 pint of sweet milk or water and stir to a mushy consistency.

Fruits and vegetables.—Using a pepper shaker, dust powdered red squill over thin slices of fresh fruit or vegetables and stir or shake as the powder is applied to insure even distribution. A small muskmelon, for example, should be cut into about 16 slices and each slice cut into 3 sections. This will require an ounce of powdered squill and will make 48 baits. Three medium-sized tomatoes or three bananas each cut into about 16 sections may be similarly used for each ounce of squill powder.

Liquid red squill should be used only with a dry bait capable of absorbing about double its weight of liquid. Cut one-half pound of stale bread into half-inch cubes, place in a clean dish, and pour 1 pint of liquid red squill over them and mix gently with a spoon. Use several cubes for each rat bait.

DISTRIBUTION OF SQUILL BAITS

In exposing squill baits the directions for distributing barium-carbonate baits, as given on pages 6–7, may be followed to advantage in a general way. Barium carbonate, being tasteless, may often be repeatedly used with success, whereas squill has a taste that, although not objectionable to rats, would probably be associated by them with the ill effects suffered from former nearly fatal doses. It is therefore desirable for best results that prebaiting be practiced and that a sufficient quantity of bait be exposed on a premises at one time to dispose of all rats present.

Although barium-carbonate baits must be moistened with water to overcome the objectionable feature of a dry powder in the mouth, squill is effective when mixed with a dry cereal meal, and should keep in good condition for a long time. A bait that keeps well may be left exposed for an indefinite period in poison caches, where it will be of value in protecting premises from rats and mice that may from time to time find their way into buildings temporarily vacated. Although the department has not found squill injurious to domestic animals, it is recommended that baits be placed where other animals will not have access to them.

OTHER POISONS

Relatively mild rat poisons, as barium carbonate or squill, are usually effective and are recommended in most cases. Sometimes, however, some of the more active poisons are necessary for complete success. In using a highly poisonous preparation additional care is necessary to prevent accident. Of the many poisons that will, when properly prepared, destroy rats, phosphorus, arsenic, strychnine, and thallium are of outstanding usefulness and form the basis of the majority of commercial rat poisons.

Phosphorus is used extensively in commercial rat poisons. It has distinctive taste, odor, and luminous properties by which it may be readily identified, but to which rats apparently do not object. Though undoubtedly effective against rats, phosphorus is dangerously

poisonous, and in the absence of a good antidote is considered unsafe for general use. Fire hazard connected with the use of commercial pastes containing this element probably exists only when the percentage of the phosphorus is too high and the paste is not thoroughly mixed.

Powdered white arsenic, or arsenious oxide, is widely used in commercial preparations for the destruction of rats. It is practically tasteless and odorless and is usually taken readily when mixed with attractive baits in the proportion of about 1 part poison to 20 parts food, although a slight grittiness detracts somewhat from its palatability. A finely pulverized, nongritty form of white arsenic has recently been demonstrated by the department to be of greatly increased toxicity. Arsenic is somewhat variable in its effect upon rats, and if they survive a first dose they will refuse subsequent baitings. It is highly toxic both when taken internally and through local external application, and great care must be exercised in its use.

Strychnine is extremely poisonous. It has a bitter taste that must be disguised if it is to be used successfully as a rat poison. Its rapid action also increases the chances that rats may die in walls and other inaccessible places in buildings. Strychnine is therefore not recommended for use in poisoning rats in buildings, but has been found useful under certain conditions in the open.

Thallium sulphate is a salt of thallium, a heavy metal similar to lead in its physical properties, which is now being extensively sold both in Europe and America as a rat poison. It is a cumulative and powerful poison, slow acting, and certain in its results. It is also tasteless and odorless, so that were it not for the grave danger attending its use it would make an ideal rat poison. Without taste or smell to identify it, however, such as have strychnine and phosphorus, thallium sulphate should be used only with the utmost caution, as it is most dangerous to human beings as well as to domestic animals.

FUMIGATION

The fumigation of rat burrows and other rat harbors is a simple and highly effective method of destroying rats and is recommended for use wherever a sufficient concentration of gas can be obtained readily. Unfortunately, however, rats are found in many places that can not be reached with gas, so that this method must usually be combined with poisoning or other methods of destruction.

In certain buildings, where insect pests, as well as rats or mice, are a serious problem, as in flour mills, grain elevators, packing houses, and even in stores and dwellings of certain types, the fumigation of the entire building with a poisonous gas becomes the most practicable method of pest riddance. This type of fumigation, however, on account of the danger involved, should be intrusted only to experienced men recommended by local health authorities.[1] Rat burrows or harbors, on the other hand, can be gassed by any intelligent person without danger of accident, if directions are carefully followed.

[1] Further information on the fumigation of buildings will be sent if a request is addressed to the Department of Agriculture.

CALCIUM CYANIDE

Of the many chemicals commonly employed for destroying rats in their harbors, crude calcium-cyanide dust is of outstanding usefulness. Calcium cyanide is a compound that rapidly gives off hydrocyanic, or prussic, acid gas when acted upon by the moisture in the air. This gas is extremely poisonous and in sufficient concentration is destructive to most animal life. It has recently come into prominence in connection with control operations directed against various rodent and insect pests, and the dust form of the compound has proved a highly effective agent in favorable situations for local extermination of rats.

Calcium-cyanide dust may be used to advantage in destroying rats in open burrows in fields, along ditch banks and levees, in city dumps and sanitary fills, around the exterior of buildings, under sidewalks, pavements, and tight floors (fig. 6), in lumber piles, rubbish, and other accumulations, in walls and hedgerows, in corncribs, and sometimes in hay or straw stacks. It is particularly suited for use on farms and poultry plants and around city dumps.

The dust is used most effectively by forcing it into rat burrows or other harbors by means of a portable dusting pump or duster with a flexible hose attached. A few strokes of the pump will fill most rat burrows with the smokelike dust, which will emerge from all connecting openings and thus indicate the extent of the system. All openings through which the dust escapes should be closed with earth, sod, or other material.

In double walls of farm buildings, lumber piles, or corncribs, where the escape of the gas can not well be prevented, it is necessary to use much more dust than in an air-tight burrow. Dusting should be done on a still day, so that drafts or air currents will not quickly carry the gas away.

In dusting corncribs some of the powder should be forced into the corn about midway between the top and bottom of the crib and then should be pumped in all around near the bottom at 3 or 4 foot intervals. A short length of iron pipe driven into the corn that is to be dusted will aid in getting the chemical well into the center of larger cribs. (Fig. 7.) It is also suggested that one or more perforated iron pipes be laid on the bottom of the crib before filling to facilitate the later entry of poisoned gas. Such pipes should extend the entire length of the crib to allow application of dust at either end, one end, of course, being plugged while the dust is pumped in at the other. Holes about a quarter of an inch in diameter should be bored along each side of the pipe at 6-inch intervals, staggered to permit an even escape of gas along its length. Pumping gas into the projecting pipes as occasion demands will enable the farmer to keep his corn free from rats.

The use of gas in haymows is less practicable, because the quantity of dust required is usually out of proportion to the results obtained.

There is little danger attending the use of calcium-cyanide dust in corn or other edible products, because the gas becomes entirely dissipated in a few hours and the residue is nonpoisonous. To be entirely safe, however, the corn should not be fed for several days after dusting.

There are several types of dusting pumps on the market suitable for use in forcing calcium-cyanide dust into rat harbors, but a foot-pump duster, similar to a bicycle pump but of greater diameter, most nearly meets requirements in poultry plants and on farms, city dumps, and other large premises. This type of duster will enable the operator to force the dust into the extremes of rat systems which

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FIG. 6.—Fumigating rat burrows under a cement floor with calcium-cyanide dust

it is impossible to reach with a less powerful pump. For use around the exteriors of residences, however, and in other places where only burrows in the ground are involved, a smaller inexpensive hand-pump duster will give satisfactory results. Dust pumps should be lubricated with powdered graphite each time they are used and always be emptied before being put away.

Caution.—Both the calcium-cyanide dust and crystals and the hydrocyanic-acid gas given off by them are extremely poisonous and should be handled with the utmost care. This poison should not be

used in inclosed buildings or transferred from the container to the duster indoors. Avoid breathing the gas given off, and always wash the hands after handling the poison. The dust rapidly deteriorates upon exposure to air, so that the cans should be quickly and tightly closed after removing part of the contents. *Store in a safe place away from the house and out of reach of children, irresponsible persons, and livestock.*

Antidotes.—For poisoning from calcium-cyanide fumes breathe fresh air and inhale ammonia fumes as a stimulant. Artificial res-

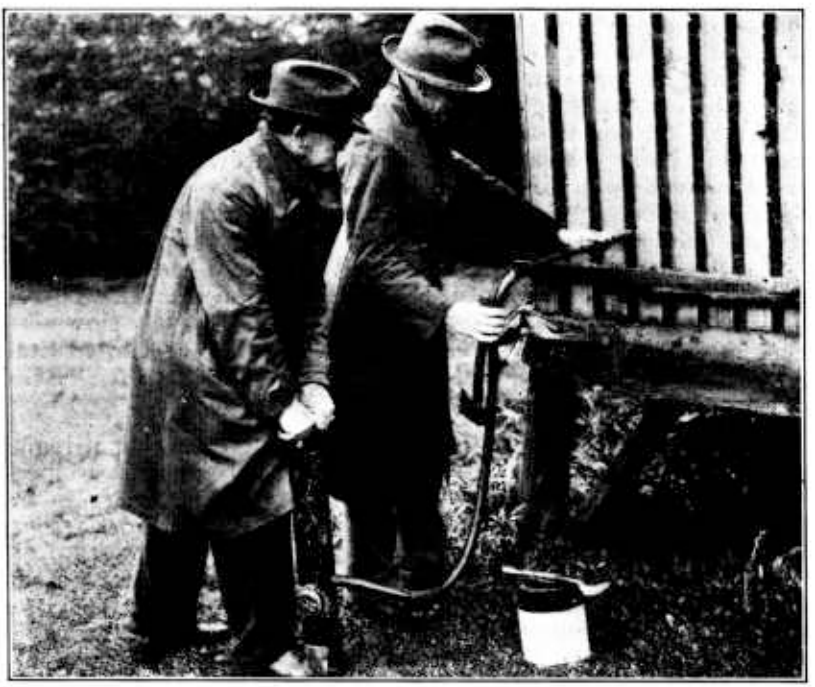

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FIG. 7.—An iron pipe driven into the corn aids in getting the fumigants well into the center of large cribs

piration should be administered if necessary. If calcium cyanide has been swallowed, the treatment to be of any avail must be undertaken with great promptness. The stomach should be immediately emptied with a stomach pump, as emetics often fail. Keep on hand 1 ounce of a 23 per cent solution of ferrous sulphate, 1 ounce of a 5 per cent solution of potassium hydroxide, and 30 grains of magnesium oxide. These should be mixed in one-half pint of water before use.

The action from cyanide poisoning is so extremely rapid, however, that there is rarely time for any antidote to be of value.

OTHER FUMIGANTS

Exhaust gases from an automobile, tractor, or other gasoline engine may be successfully used in destroying rats in their burrows, beneath floors, and in other reasonably tight inclosed places. The

exhaust is directed into the rat burrow by means of a hose, and the entrance around the hose and all connecting entrances through which the gas escapes are sealed with damp earth. The carbureter is adjusted to obtain a rich mixture and the engine allowed to run at moderate speed for 10 minutes or longer.

Carbon disulphide is effective in destroying rats in their burrows in the ground and may be used in fields or in holes in dirt floors in chicken houses, cellars, and similar places. The gas is more effective in heavy damp soils and during wet weather. A wad of cotton or other absorbent material should be saturated with 1 ounce (about 2 tablespoonfuls) of carbon disulphide and pushed as far as possible into each burrow entrance. Entrances should then be closed with moist earth to prevent the escape of the gas. Long forceps are convenient for handling the absorbent materials.

Caution.—Carbon disulphide is highly inflammable and explosive and should be kept away from all fire. As it evaporates rapidly, it should be kept in an air-tight container.

Sulphur dioxide, acetylene, and chlorine are used for exterminating rats and all are successful when properly applied. Sulphur dioxide particularly is widely used in Europe and has the advantage of being the least dangerous of the fumigants mentioned. The difficulties connected with its use, together with its relatively slow action, however, have prevented its becoming popular in the United States.

TRAPPING

Trapping rats is just as effective as poisoning them, but it requires more skill and labor. It is recommended where the use of poison seems inadvisable. Careful attention to detail is necessary in trapping rats, as success will depend largely upon the skill and resourcefulness with which the traps are handled.

Although the more complicated traps and devices for catching rats are sometimes useful, the simple and inexpensive snap trap, sometimes called "guillotine," "spring," or "break back," has proved the most effective and consistent rat catcher. There is little choice among standard makes of this style of trap; selection should be governed by apparent strength and durability. The essential part is a very sensitive trigger provided with a hook or some other means of holding the bait fast. Large triggers have the advantage over small ones in providing a greater surface for the rat to step on and in being better adapted for use along walls and narrow runways, places where rats can be trapped successfully without baiting.

To get the best results the following directions for baiting and setting snap traps should be carefully followed:

KINDS OF BAIT

The selection of baits for trapping is as important as in poisoning. Fresh baits, changed daily, should be used. A variety of baits, such as meat, vegetables, and cereals, on successive traps will usually give better results than only one kind of bait.

One of the best single baits is doughnut. Bread is also good, but both of these must be fresh, for a rat will usually ignore them when only a little stale. Among other foods that may be used as alterna-

tive baits are raw or cooked meats, bacon, fish, apple, melon, tomato, carrot, and nut meats. These may sometimes be made more attractive by sprinkling rolled oats, corn meal, or powdered milk lightly over the trap. Cheese, although an excellent bait for house mice, is not attractive usually to rats. Almost any food suitable for human consumption will appeal to the gluttonous appetite of the rat, so that there should be no lack of variety.

WHERE TO SET SNAP TRAPS

Rats rely on concealment for protection and avoid open spaces as much as possible. The best place to set traps, therefore, is close to walls, behind objects, in dark corners, or in any place where a

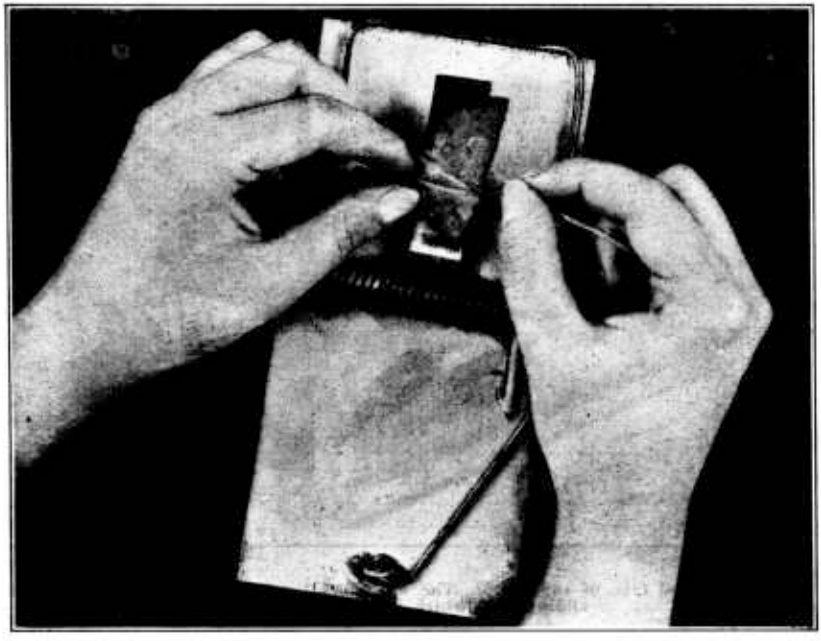

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FIG. 8.—Baits should be tied to trigger so that the rat will be sure to spring the trap

rat would run for concealment. Traps should be set in such a manner that the rat in following its natural course will pass directly over the trigger. For example, in setting along a wall the trap should extend from the wall at right angles, the trigger end close against it. Boards may be leaned lengthwise against walls to form natural runways for rats and good places to set traps.

HOW TO SET SNAP TRAPS

Baits should be large and fastened securely to the trigger by means of the trigger hook or tied with thread or fine wire, so that the rat will be sure to spring the trap when attempting to remove them. (Fig. 8.) Traps should be set lightly to allow them to spring easily.

After most of the rats have been caught, the others sometimes leave the premises. Oftener, however, the remaining rats are not frightened away but avoid baits and prove difficult to catch. Strategy must be used in outwitting such individuals, and the most successful method is to camouflage the traps. Traps set on the ground may be sunk slightly below the surface. A small piece of paper or cloth should then be placed over the trigger end of the trap to prevent dirt from getting underneath and clogging the action, and the whole should be lightly covered with fine earth or sawdust. The same method may be employed on hard floors by burying the trap in a shallow pan of meal, sawdust, or grain. A trap set in this way may be placed in a runway without baiting, or several pieces

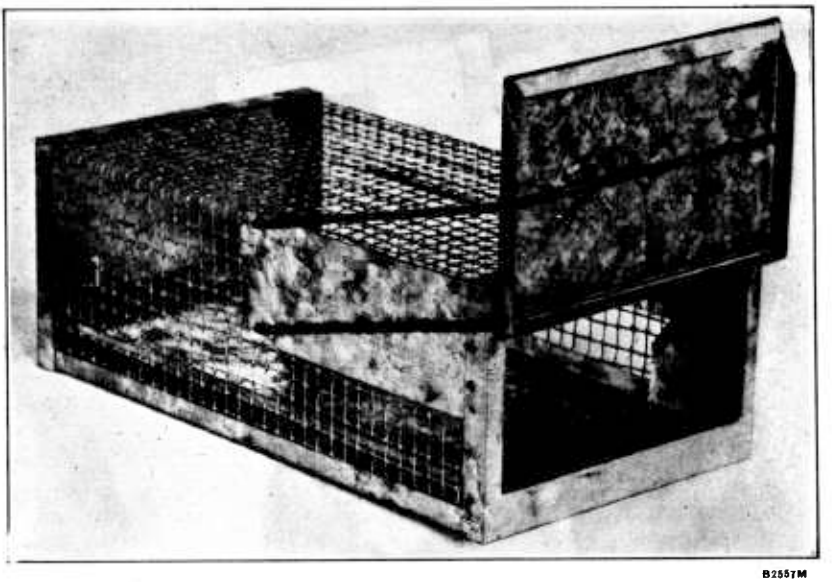

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FIG. 9.—A good type of cage trap. The weight of the rat on the floor releases the sliding end, which is raised when set

of bait may be scattered over it. In stubborn cases food may be exposed on pans of meal until the rats take it readily, after which the traps should be set in the meal. Stones, boxes, or boards will often serve to guide rats along an easy path over a trap.

CAGE TRAPS

Cage traps are in general less efficient than snap traps, although they are capable of catching a large number of rats at one time. Most of them are self setting. A particularly effective trap of the cage type is a box-shaped wire-and-metal device, one end of which is raised and open when set. The end drops into place when released by the weight of the rat on the floor of the trap. (Fig. 9.) The well-known French wire-cage traps will sometimes get desired results, but are not recommended for general use, although they have

been improved somewhat with a simple wire catch that holds the trapdoor open until the first rat has entered. Other rats are more likely to venture into the trap after the first one has been caught.

There are a large number of other cage traps and similar devices, many of which have some merit but no outstanding feature that would warrant describing them here. Cage traps of any kind are made more attractive by covering them with old burlap bags, straw, or other handy material. They should be set in places where rats are accustomed to feed and should be baited with a variety of baits as suggested for snap traps.

GENERAL TRAPPING INSTRUCTIONS

An abundance of accessible food for rats makes trapping much more difficult. Before starting a trapping campaign put all food out of reach and stop the sources of supply. Plenty of traps should be used. Trying to catch a hundred rats with half a dozen traps will make those not caught suspicious and dishearten the trapper long before the job is half done. A dozen or more traps for a heavily infested dwelling and from 50 to 100 or more for farms and larger buildings are not too many. It is important that a sufficient number be obtained to make the campaign short and decisive. The cost of traps is little compared with the damage caused by rats.

Traps should be kept in good working condition and carefully examined before setting to insure their instant operation. They should be kept reasonably clean, and may be boiled and scraped if they become foul. When trapping is done on a large scale, especially in damp places where metal parts of traps may rust, an occasional dipping in melted paraffin will lengthen their usefulness, cause them to spring more easily, and have a deodorizing effect.

Trapping rats in larger buildings and on farms should be assigned to a man with a natural aptitude for such work. When interest is taken, only slight training is necessary for some men to become proficient in the work, and these should be encouraged to persistent effort.

USE OF VIRUSES

Rat viruses on the American market contain living organisms, or bacteria, known as the Danysz bacillus, which when ingested by rats is said to cause a disease that is followed by great mortality. In extensive experiments with rats conducted by bacteriologists of the Department of Agriculture, however, even the most virulent cultures failed to produce a high percentage of deaths, while the majority of the viruses tested were practically ineffective. Also the disease produced was found not to be contagious, except when one rat ate another. Thus there is little probability of the disease spreading to an appreciable extent. There also appears to be well-founded doubt as to the harmlessness of rat viruses. The Danysz bacillus belongs to the same group as the food-poisoning bacilli and is indistinguishable from them. Although it has not been possible directly to trace many cases of human food poisoning to rat viruses, two State boards of health have prohibited their sale within the States. For these reasons the department does not recommend the use of viruses for the destruction of rats.

DETERRENTS

Rats appear to have a marked aversion for certain odors and seem consistently to avoid them. This allows their use as rat deterrents, and this method has been found useful under certain conditions. In seed warehouses and similar structures where sacked grain is stored, it has been found that a liberal application of flake naphthalene scattered on the floor about the stacked grain and over the bags is objectionable to rats and will keep them away, and it does not damage the seed. Because of its odor the use of naphthalene is not recommended in places where food and foodstuffs are stored, unless the nature of the material is such that it can be thoroughly deodorized by airing before use.

There are many other compounds said to be objectionable to rats, chiefly creosote, carbolic acid, and other coal and wood tar derivatives, kerosene, and oils of peppermint and wintergreen.

Compounds that rats avoid may often be used where an odorous preparation would be objectionable. Among these are powdered sulphur, lime, lye, and copperas. Sulphur particularly has been used successfully in protecting stored grains, such as corn, from the ravages of rats.

Deterrents may often be used to advantage to prevent reoccupation of old burrows and other rat habitations after a successful campaign of destruction.

DEODORANTS

There is always the possibility that a rat will die in an inaccessible place, where its body will decay and cause obnoxious odors, particularly if near steam pipes or other warm place. In such cases the nuisance can be abated to some extent by the use of a deodorant that will absorb, neutralize, or destroy the offensive odors of putrefaction.

Of a number of deodorizing compounds tested in the laboratory, lysol was found most effective in counteracting putrefactive odors. If possible, a small hole should be bored through the wall in the vicinity of the supposed point of origin and several tablespoonfuls of lysol inserted, after which the hole may be plugged. Pine-wood oil or perfume may also be added if desired. Zinc chloride may be used in the same manner.

One-half dram of lead nitrate mixed in 1 pint of boiling water and then added to a pail of cold water in which 2 drams of salt are dissolved makes a good deodorant solution. A large cloth should be saturated in the solution and hung in the room in which the odor is present.

NATURAL ENEMIES OF RATS

A good rat dog is almost indispensable on farms where old buildings offer ideal quarters for rats and constantly attract large numbers of them. Small terrier dogs, particularly when taught to hunt by themselves, will often keep a farm free from rats. (Fig. 10.) Cats that are of real value as ratters are rare, and they are usually destructive to bird life. When confined, however, in warehouses, produce depots, and similar places in cities, good cats are sometimes of value

in destroying rats and mice. Ferrets are of little use ordinarily except in the hands of experienced men aided by good rat dogs.

Although naturally burrowing rodents, rats do not ordinarily become excessively abundant in fields and woodlands because of their numerous natural enemies among the smaller mammals and birds of prey. If the relation of hawks and owls to rat infestation on the farm were better understood, the killing of such valuable birds would be confined to those actually caught preying upon poultry, and others would be left to their work of reducing the number of rats and other injurious rodents. This policy would tend to lessen

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FIG. 10.—A small terrier dog, if taught to hunt by itself, will sometimes keep a farm free from rats

the numbers of the three species of hawks and owls that live to any considerable extent on poultry and birds,[2] while the more than 40 beneficial species of predacious birds of these groups would be spared.

COMMUNITY COOPERATION IN RAT CONTROL

Although getting rid of rats is largely an individual problem, rat infestation has a serious effect on the whole community, and organ-

[2] Those harmful hawks and owls are the Cooper hawk (*Accipiter cooperi*), the sharp-shinned hawk (*Accipiter velox*), and the great horned owl (*Bubo virginianus*). The duck hawk (*Rhynchodon peregrinus anatum*) and the goshawk (*Astur gentilis atricapillus*) are also classed as injurious but are too rare to be of consequence. The Cooper and sharp-shinned hawks destroy 90 per cent of the poultry and birds for which hawks and owls are responsible. The great horned owl is capable of great service in combating rats and other rodents and becomes a pest only where these are scarce and poultry is allowed to run at large. See FISHER, A. K., HAWKS AND OWLS FROM THE STANDPOINT OF THE FARMER. U. S. Dept. Agr., Bur. Biol. Survey Circ. 61, 18 p., illus. 1907.

ized control effort is highly desirable. A person who allows rats to increase on his property until they menace the entire neighborhood becomes an object of public concern, and a city that permits its refuse dump to serve as a breeding ground for hordes of these pests is committing a grave injustice to its population. Ridding a whole community of rats can best be accomplished by the organized efforts of all the citizens. Campaigns are being conducted regularly in an increasing number of counties and municipalities and are proving of great value in stimulating popular interest and in teaching better methods in rat control. Local public-spirited organizations, as chambers of commerce, citizens' associations, civic societies, women's clubs, and farmers' organizations, as well as 4–H clubs and boy scouts' and other boys' and girls' clubs, are recognizing the value to the community of organized warfare on rats and are taking the lead in planning and directing antirat campaigns.

ANTIRAT LEGISLATION

As stated before, the most important factors in the general control of the rat pest are modern methods of construction and sanitation. For the most part, and even without thought of rats, modern construction is rat-proof, and it could be made wholly so with little additional effort or cost. Legislation, however, is necessary to insure rat-proof construction and to provide adequate facilities for proper collection and disposal of waste. Several cities already have passed antirat ordinances, and many have regulations requiring fire stops in double walls, which are a necessary part of the rat-proofing program. Rat-proofing should not end with fire-stopping, however, but should require, under rigid inspection, that all new structures be so planned and built that rats and mice will not be able to gain ready entrance or find shelter if they accidentally do get in.

Such regulations are urgently needed if the rat is to be shut out of every new structure and ultimately built out of the country and possibly out of existence.

SUMMARY

Rat-proof all new buildings. Close all openings through which rats can gain entrance. Remove all shelter for rats. Promptly dispose of all garbage, trash, and other waste on which rats can feed.

Destroy the rats themselves by use of poisoned baits. If unwilling to run the slight risk of rats dying in inaccessible places, use traps. Fumigate rat burrows and hiding places with poisonous gases.

Protect natural enemies of the rat when they are not themselves destructive, and if convenient keep a small dog trained to hunt rats.

Note neighborhood sources of rats, enlist community cooperation for their removal, and work for practical rat-control ordinances in cities and towns.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

May 21, 1930

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